

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

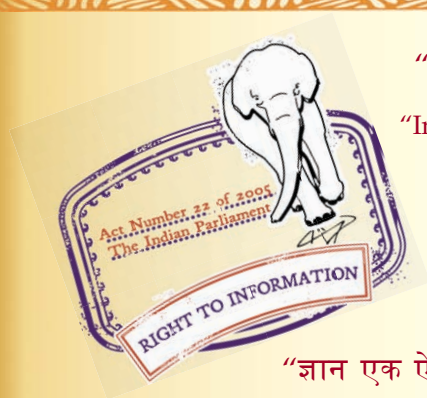
“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 11852-4 (2001): Automotive Vehicles - Brakes and Braking Systems, Part 4: Compressed Air and Air Assisted Brakes - Special Requirements [TED 4: Automotive Braking Systems]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



भारतीय मानक

स्वचल वाहन — ब्रेक और ब्रेकिंग तंत्र
भाग 4 संपीडित हवा और हवा सहायी ब्रेक — विशेष अपेक्षाएं
(पहला पुनरीक्षण)

Indian Standard

**AUTOMOTIVE VEHICLES — BRAKES AND
BRAKING SYSTEMS**

PART 4 COMPRESSED AIR AND AIR ASSISTED BRAKES — SPECIAL REQUIREMENTS

(First Revision)

ICS 43.040.40

© BIS 2001

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (Part 4) (First Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Automotive Braking Systems Sectional Committee had been approved by the Transport Engineering Division Council.

This standard on brakes and braking systems which was earlier issued in eight parts, has now been revised and issued in nine parts which are as under:

- Part 1 Terminology;
- Part 2 General functions and features;
- Part 3 Performance requirements and evaluation;
- Part 4 Compressed air and air assisted brakes — Special requirements;
- Part 5 Compressed air and air assisted brakes — Pressure test connections;
- Part 6 Vacuum braking systems — Special requirements;
- Part 7 Inertia dynamometer test method for brake linings;
- Part 8 Test procedures; and
- Part 9 Requirements for vehicles equipped with anti-lock braking devices.

IS 11852 (Part 7) : 1995 Automotive vehicles — Recommendations for brakes and braking systems: Part 7 Model test report has been withdrawn in this revision and has been replaced with a part covering ‘Inertia dynamometer test methods for brake linings’. Part 9 covering the requirements for vehicles equipped with anti-lock braking devices has been added.

This standard is mainly based on EEC directives 71/320, 74/132, 75/524, 79/489, 85/647, 88/194 & 91/422 relating to the braking devices of certain categories of motor vehicles and of their trailers. However, apart from the changes made from EEC directives to suit the Indian conditions, the nomenclature of some of the tests and categories of vehicle have also been changed as under:

<i>EEC Directives</i>	<i>Indian Standards</i>
Category ‘O’ Vehicle	Category ‘T’ Vehicle
Type ‘O’ test	Type ‘P’ test
Type I test	Type ‘F’ test
Type II test	Type ‘H’ test

Assistance has also been derived from ECE regulation No. 13 (Annex 7 — Part A).

The composition of the Committee responsible for formulation of this standard is given in Annex A.

Indian Standard

AUTOMOTIVE VEHICLES — BRAKES AND BRAKING SYSTEMS

PART 4 COMPRESSED AIR AND AIR ASSISTED BRAKES — SPECIAL REQUIREMENTS

(First Revision)

1 SCOPE

This standard (Part 4) covers special requirements applicable to compressed air and compressed air assisted braking systems (using compressed air as media of energy) for both motor vehicles and trailers. The requirements covered are:

- a) Capacity of reservoirs,
- b) Capacity of energy sources,
- c) Reaction time and its method of measurements, and
- d) Spring brakes.

1.1 This standard is not applicable to the following types of vehicles:

- a) Agricultural tractors and power tillers;
- b) Earth moving machinery;
- c) Construction equipment vehicles;
- d) Vehicles moving on rails;
- e) Two wheelers;
- f) Three wheelers; and
- g) Vehicles with maximum designed speed not exceeding 25 km/h.

2 REFERENCES

The following Indian Standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
11852	Automotive vehicles — Brakes and braking systems:
(Part 2) : 2001	General functions and features (<i>first revision</i>)
(Part 5) : 2001	Compressed air and air assisted brakes — Pressure test connections (<i>first revision</i>)

3 CAPACITY OF RESERVOIRS

3.1 General Requirements

3.1.1 Vehicles in which the operation of the braking

systems depends on the use of compressed air shall be fitted with reservoirs of a capacity meeting the requirements of 3.2 and 3.3.

3.1.2 However, the energy storage devices shall not be required to be of a prescribed capacity if the braking system is such that in the absence of any energy reserve it is possible for the system to achieve braking performance at least equal to that prescribed for the secondary braking systems.

3.1.3 When verifying compliance with the requirements of 3.2 and 3.3 the brakes shall be adjusted as closely as possible.

3.2 Motor Vehicles of Category M and N

3.2.1 The air brake reservoirs of motor vehicles shall be so designed that after eight full stroke actuations of the service brake control, the pressure remaining in the air brake reservoir shall be not less than the pressure required to obtain the specified secondary braking performance.

3.2.2 During the test, the following requirements shall be satisfied.

3.2.2.1 The initial pressure in the reservoirs shall be that indicated by the manufacturer. This pressure, P_2 shall be such as to enable the prescribed performance for the service braking to be achieved (*see 4.2.2*).

3.2.2.2 The reservoir or reservoirs shall not be replenished. In addition, the reservoir or reservoirs of auxiliary equipment shall be isolated.

3.2.2.3 In the case of motor vehicles to which the coupling of a trailer or semi-trailer is authorised, the feed line (emergency line) shall be blocked off and a reservoir of 0.5 litre capacity shall be connected to the control line (service line). The pressure in this reservoir shall be exhausted before each actuation of the brakes. After the test referred to in 3.2.1, the pressure in the control line shall not be less than one half of the pressure obtained at the first brake application.

3.3 Trailers (Including Semi-Trailers) of Category T

3.3.1 Reservoirs fitted to the trailers shall be such that, after eight full stroke actuations of the towing vehicle's

service braking device, the pressure supplied to the operating parts using it does not fall below a level equal to one half of the value obtained at the first brake application and without actuating either the automatic or the parking brake of the trailer.

3.3.2 During the test, the following requirements shall be satisfied.

3.3.2.1 The maximum pressure ($P_{\max}$) in the reservoirs at the beginning of the test shall be equal to the maximum specified by the manufacturer.

3.3.2.2 The supply line shall be blocked-off. In addition, the auxiliary equipment reservoirs shall be isolated.

3.3.2.3 The reservoir shall not be replenished during the test.

3.3.2.4 For each application of the brakes, the pressure in the control line shall correspond to the maximum specified by the manufacturer ($P_{\max}$).

4 CAPACITY OF ENERGY SOURCES

4.1 General Provisions

Compressors shall satisfy the requirements laid down in 4.2 to 4.5.

4.2 Definitions

4.2.1 P_1 is the pressure corresponding to 65 percent of the pressure P_2 specified by the manufacturer.

4.2.2 t_1 is the time required for the reservoir pressure to rise from zero to P_1 and t_2 is the time required for the reservoir pressure to rise from zero to P_2 .

4.3 Conditions of Measurement

4.3.1 In all-cases the speed of the compressor (in rev/min) shall be that obtained when the engine is running at the speed corresponding to the maximum power or at the speed allowed by the governor.

4.3.2 The auxiliary equipment reservoirs shall be isolated during the tests for determining the periods t_1 and t_2 .

4.3.3 Where spring brakes are used, they are to be in brake released condition.

4.3.4 On motor vehicles constructed to tow trailers, the trailer shall be represented by a reservoir whose maximum pressure, P (expressed in bars) is that which can be supplied through the feed circuit of the towing vehicle and whose volume, V (expressed in litres), is given by the formula $P \times V = 20R$ (R being the permissible maximum load expressed in tonnes on the axles of the trailer or semi-trailer).

4.4 Interpretation of Results

4.4.1 The time t_1 for the least favourable reservoir shall not exceed:

- a) three minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is not authorized, and
- b) six minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is authorised.

4.4.2 The time t_2 for the least favourable reservoir shall not exceed:

- a) six minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is not authorised, and
- b) nine minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is authorised.

4.5 Additional Test

4.5.1 When the vehicle is equipped with an auxiliary equipment reservoir or reservoir with a total capacity exceeding 20 percent of the total capacity of the brake reservoirs, an additional test shall be carried out during the course of which there shall be no interference with the functioning of the valves controlling the filling of the auxiliary equipment reservoirs(s). A check shall be made during the course of this test that the period t_3 required to bring about a rise in the pressure in the brake reservoirs from zero to P_2 is less than:

- a) eight minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is not authorised, and
- b) eleven minutes in the case of vehicles to which the coupling of a trailer or semi-trailer is authorised.

4.6 Towing Vehicles

4.6.1 Vehicle to which the coupling of a category T vehicle is authorised shall also comply with the above requirements. For vehicles not so authorised, the tests in 4.4.1, 4.4.2 and 4.5.1 shall be conducted without the reservoir mentioned in 4.3.4.

5 METHOD OF MEASURING THE REACTION TIME

5.1 General Requirements

5.1.1 The reaction time for the braking device shall be determined with the vehicle stationary, the pressure being measured at the opening of the least favourable brake cylinder. In the case of vehicles fitted with combined compressed air/hydraulic braking systems, the pressure may be measured at the opening of the

least favourable pneumatic unit.

5.1.2 During the test, the stroke of the brake cylinders of the individual axles shall be that corresponding to the most closely adjusted brakes.

5.1.3 The times determined in implementing the provisions of this standard shall be rounded off to the nearest tenth of a second. If the figure representing the 1/100th is five or more, the reaction time shall be rounded up to the next higher tenth.

5.2 Motor Vehicles

5.2.1 At the start of each test, the pressure in the reservoir shall be equal to the minimum pressure at which the governor starts feeding the installation again. For installations not fitted with a governor, (for example, pressure limited compressor), the pressure in the reservoir at the start of each test shall be equal to 90 percent of the pressure stated by the manufacturer, as defined in 3.2.2.1. Air supply shall be cut off during each test.

5.2.2 The reaction time is determined as the time clapsing between the beginning of the actuation of the control pedal and the moment the pressure in the braking cylinder reaches 75 percent of its asymptotic value.

5.2.3 Reaction times, in terms of actuation times, shall be obtained by a series of actuations to the fullest extent starting from the shortest possible time to about 0.45 second. The values so measured shall be given on a graph from which the reaction time corresponding to an actuation time of 0.2 second shall be determined by interpolation.

5.2.4 The reaction time measured from the above graph for an actuation time of 0.2 second shall not exceed 0.6 second.

5.2.5 In the case of motor vehicles having a brake coupling for trailers, in addition to the requirements of 5.1, the reaction time shall be measured at the extremity of a pipe 2.5 m long with an internal diameter of 13 mm which shall be joined to the coupling head of the control line of the service brake. During this test, a volume of $385 \pm 5 \text{ cm}^3$ to represent the extra volume of 2.5 m long pipe shall be connected to the coupling head of the supply line.

5.2.5.1 Tractive units for semi-trailers shall be equipped with flexible lines for making the connection to semi-trailers. The coupling heads shall, therefore, be at the extremity of these flexible lines. The length and internal diameter of the lines shall be entered in report for type approval.

5.2.6 The time which elapses between the start of the activation of the control pedal and the moment when

the pressure measured at the coupling head of the control pipe reaches the specified value percentage at its asymptotic value shall not exceed the values listed below:

<i>Pressure (as percent)</i>	<i>Time (seconds)</i>
10	0.2
75	0.4

5.2.7 In the case of motor vehicles authorized to draw trailers of category T3 or T4 fitted with compressed air braking systems, in addition to the above mentioned requirements, the requirements of 4.2.1.19(a) of IS 11852 (Part 2) shall be verified by conducting the following tests:

- by measuring the pressure at the extremity of a pipe 2.5 m long with an internal diameter of 13 mm which shall be joined to the coupling head of the supply line.
- by simulating a failure of the control line at the coupling head.
- by actuating the service braking control device in 0.2 second as described in 5.2.3.

5.3 Trailers (Including Semi-Trailers)

5.3.1 The reaction times for trailers shall be measured without a towing vehicle. To simulate the towing vehicle, it is necessary to provide a simulator to which the coupling heads of the control line and of the feed line of the trailer are to be connected.

5.3.2 The pressure in the feed line shall be 6.5 bars.

5.3.3 The simulator shall have the following features;

5.3.3.1 It shall have a reservoir with a capacity of 30 litres which shall be charged to a pressure of 6.5 bars before each test and which shall not be re-charged during each test. At the outlet of the braking control device the simulator shall incorporate an orifice with a diameter of 4.0 and 4.3 mm. The volume of the pipe measured from the orifice up to and including the coupling head shall be $385 \pm 5 \text{ cm}^3$ (to represent the extra volume of 2.5 m long pipe). The control line pressure referred to in 4.3 shall be measured immediately downstream of the orifice.

5.3.3.2 The braking control device shall be so designed that its performance in use is not affected by the tester.

5.3.3.3 The simulator shall be set, for example, through the choice of orifice in accordance with 5.3.3.1, in such a way that, if a reservoir of $385 \pm 5 \text{ cm}^3$ is attached to it, the time taken for the pressure to increase from 0.65 to 4.9 bars (10 percent and 75 percent respectively of the nominal pressure of 6.5 bars) shall be 0.2 ± 0.01 second. If a reservoir of $1\,155 \pm 15 \text{ cm}^3$ is substituted for the above mentioned

reservoir, the time taken for the pressure to increase from 0.65 to 4.9 bars without further adjustment shall be 0.38 ± 0.02 second. Between these two pressure values, the pressure shall increase in an approximately linear way. These reservoirs shall be connected to the

coupling head without using flexible pipes. The connections shall have an internal diameter of not less than 10 mm.

5.3.3.4 Figures 1 and 2 give examples of the correct configuration and use of the simulator.

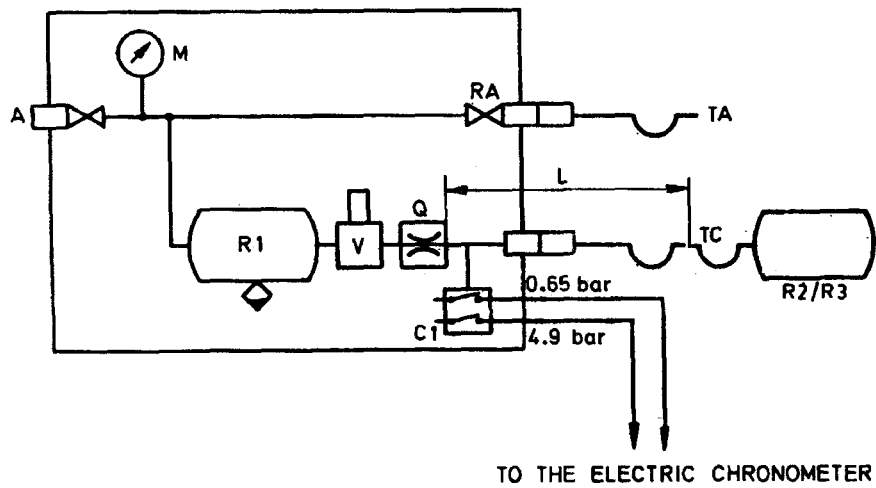


FIG. 1 SETTING OF THE SIMULATOR

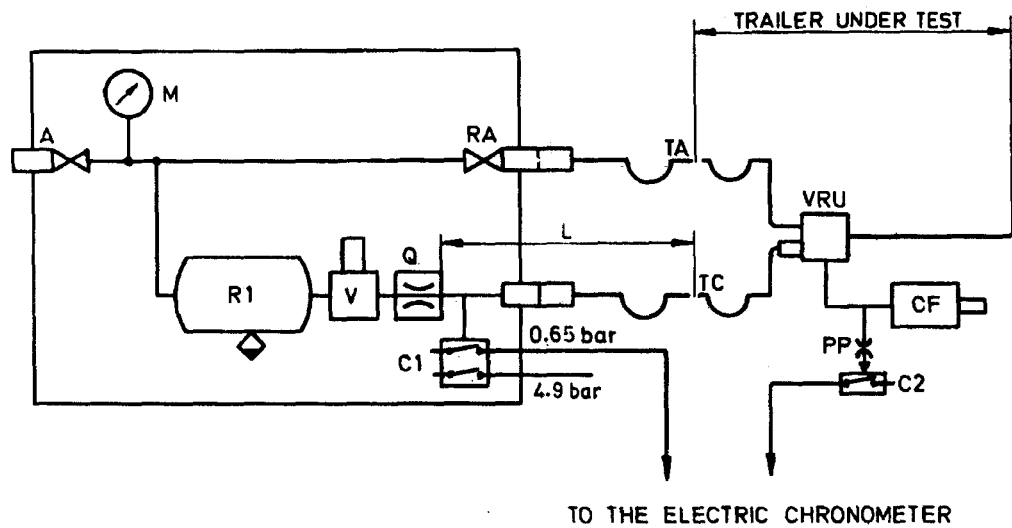


FIG. 2 TESTING THE TRAILER BRAKE SYSTEM VIA THE SIMULATOR

- A = Supply connection with shut-off valve

C1 = Pressure switch in simulator, set at 0.65 bar and at 4.9 bar

C2 = Pressure switch to be connected to brake actuator of trailer to operate at 75 percent of asymptotic pressure in the brake actuator CF

CF = Brake actuator

L = Line from orifice Q up to and including its coupling head TC having an inner volume of $385 \pm 5 \text{ cm}^3$ under a pressure of 6.5 bars

M = Pressure gauge

O = Orifice with a diameter of not less than 4 mm and not more than 4.3 mm
- PP = Pressure test connection

R1 = 30 litres air reservoir with drain valve

R2 = Calibrating reservoir including its coupling head TC to be $385 \pm 5 \text{ cm}^3$

R3 = Calibrating reservoir including its coupling head control line, TC to be $1\,155 \pm 15 \text{ cm}^3$

RA = Shut-off valve

TA = Coupling head, supply line

TC = Coupling head, control line

V = Braking control device

VRU = Emergency relay valve

5.3.4 The time elapsing between the moment when the pressure produced in the control line by the simulator reaches 0.65 bar and the moment when the pressure in the brake actuator of the trailers reaches 75 percent of its asymptotic value shall not exceed 0.4 second.

6 PRESSURE TEST CONNECTIONS

6.1 Pressure test connections shall be provided on all vehicles offered for type approval.

6.2 A pressure test connection shall be fitted close to the least favourably placed reservoir within the meaning of 4.4.

6.3 On each independent circuit of the braking system a pressure test connection shall be fitted as closely as possible to the brake cylinder which is the least favourably placed as far as reaction time is concerned.

6.4 The pressure test connections shall comply with IS 11852 (Part 5).

7 SPRING BRAKES

7.1 General Requirements

7.1.1 Spring brake shall not be used as a service brake.

7.1.2 A small variation in any of the pressure limits which may occur in the spring compression chamber feed circuit shall not cause a significant variation in the braking force.

7.1.3 The feed circuit to the spring compression chamber shall either include an own energy reserve or shall be fed from at least two independent energy reserves. The trailer supply line may be branched from this supply line under the condition that a pressure drop in the trailer supply line shall not be able to apply the spring brake actuators. Auxiliary equipment may only draw its energy from the supply line for the spring brake actuators under the condition that its operation, even in the event of damage to the energy source cannot cause the energy reserve for the spring brake actuators to fall below a level from which one release of the spring brake actuators is possible. In any case, during re-charging of the braking system from zero pressure, the spring brakes shall not release until the pressure in the service braking system is sufficient to ensure at least the prescribed secondary braking performance of the laden vehicle, using the service brake control. This requirement does not apply to trailers.

7.1.4 In motor vehicle, the system shall be so designed that it is possible to apply and release the brakes at least three times with the initial pressure in the system being same as that referred to in 3.2.2.1. In the case of trailers, it shall be possible to release the brakes at least three times after the trailer has been uncoupled, the pressure in the supply line being 6.5 bars before

uncoupling. These conditions shall be satisfied when the brakes are adjusted as closely as possible. In addition, it shall be possible to apply and release the parking brake as specified in 4.2.2.10 of IS 11852 (Part 2), when the trailer is coupled to the towing vehicle.

7.1.5 In case of motor vehicles, the pressure in the spring compression chamber beyond which the springs begin to actuate the brakes, the latter being adjusted as closely as possible, shall not be greater than 80 percent of the minimum level of the normal available pressure (P_2).

7.1.5.1 In case of trailers, this pressure level is the pressure which is obtained after four stroke actuations of the service brake control. The initial pressure is fixed at 6.5 bars.

7.1.6 When the pressure in the line feeding energy to the spring compression chamber excluding lines of an auxiliary release device using a fluid under pressure, falls to the level at which the brake parts begin to move, an optical or audible warning device as specified in 4.2.1.13 of IS 11852 (Part 2) shall be actuated. This provision does not apply to trailers.

7.1.7 On motor vehicles fitted with spring brakes and authorised to draw trailers with continuous or semi-continuous brakes, automatic application of the spring brakes shall cause the trailer brakes to be applied.

7.2 Release System

7.2.1 A spring braking system shall be so designed that, in the event of a failure in that system, it shall make it possible to release the brake. This may be achieved by the use of an auxiliary release device (pneumatic, mechanical, etc). Auxiliary release devices using an energy reserve for releasing, shall draw their energy from an energy reserve which is independent from the energy reserve normally used for the spring braking system.

The pneumatic or hydraulic fluid in such an auxiliary release device may act on the same piston surface in the spring compression chamber, which is used for the normal spring braking system, under the condition that the auxiliary release device uses a separate line. The junction of this line with the normal line connecting the control device with the spring brake actuators, shall be each spring brake actuator immediately before the port to the spring compression chamber, if not integrated in the body of the actuator. This junction shall include a device which prevents an influence of one line on the other. The requirements of 4.2.1.6 of IS 11852 (Part 2) also apply to this device.

7.2.2 If the operation of the auxiliary device referred to in 7.2.1 requires the use of a tool or spanner, the tool or spanner shall be available in the tool kit of the vehicle.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Automotive Braking System Sectional Committee, TED 4

Chairman

SHRI R. C. SETHI

Members

SHRI N. KURUPPALAH
SHRI K. SENTHIL KUMAR } (Alternates to
Shri R.C. Sethi)

SHRI VIJAY KUMAR

SHRI RAJESH GOYAL (Alternate)

SHRI R. R. G. MENON

SHRI B. GHOSH

SHRI M. S. OGALE (Alternate)

SHRI T. M. BALARAMAN

SHRI C. Y. DESHPANDE (Alternate)

SHRI V. S. VENKATESAN

SHRI K. N. BALAJI (Alternate)

SHRI H. CHANDIRAMANI

SHRI R. M. KANITKAR (Alternate)

SHRI D. G. SHIRKE

SHRI V. R. JALGAONKAR (Alternate)

SHRI D. K. SHUKLA

SHRI D. CHATTERJEE (Alternate)

SHRI DINESH TYAGI

SHRI D. DOGRA (Alternate)

SHRI S. VENKATATESH

SHRI S. JAYA KUMAR (Alternate)

SHRI S. RAMASWAMY

DR V. G. NAIK (Alternate)

SHRI HARJIT SINGH

SHRI R. K. JAIN (Alternate)

SHRI J. S. KHADILKAR

SHRI VINOD R. KULKARNI (Alternate)

SHRI V. R. MARATHE

SHRI P. V. BHANDRE (Alternate)

SHRI R. SIVA KUMAR

SHRI I. V. RAO

SHRI DEEPAK SAWKAR (Alternate)

SHRI V. C. MATHUR

SHRI B. N. DAS (Alternate)

SHRI K. V. RAMI REDDY

SHRI M. K. MISHRA

SHRI R. G. KAREMORE (Alternate)

SHRI V. R. KULKARNI

SHRI S. RAMANATHAN (Alternate)

SHRI S. N. SRINIVASAN

SHRI V. MURUGAN (Alternate)

SHRI V. RAMAKRISHNAN

SHRI S. M. IQBAL (Alternate)

SHRI VEENU MATHUR

SHRI Y. V. NAGARAJ (Alternate)

SHRI P. D. JOSHI

SHRI C. M. MEHTA (Alternate)

SHRI L. S. JAYARAMAN

SHRI V. R. JANARDHANAM (Alternate I)

SHRI K. N. RAVI (Alternate II)

Representing

VRDE, Ahmednagar

Allied Nippon Ltd, New Delhi

Ashok Leyland Ltd, Chennai

Automotive Research Association of India, Pune

Bajaj Auto Ltd, Pune

Brakes India Ltd, Chennai

Bajaj Tempo Ltd, Pune

Central Institute of Road Transport, Pune

Controllerate of Quality Assurance (Vehicles), Jabalpur

Daewoo Motors India Ltd, Dadri

Eicher Motors Ltd, Pithampur

Hindustan Composites Ltd, Mumbai

HMT Ltd (Tractor Division), Pinjore

Kalyani Brakes Ltd, Pune

Kinetic Engineering Ltd, Pune

Mahindra & Mahindra Ltd, Nasik

Maruti Udyog Ltd, Gurgaon

Ministry of Heavy Industries and Public Enterprises, Department of Heavy Industries,
New Delhi

Ministry of Surface Transport, New Delhi

Ordnance Factory Board, Calcutta

Pal-Peugeot Ltd, Dombivli (East), Thane

Premier Automobiles Ltd, Mumbai

Rane Brake Linings Ltd, Chennai

Royal Enfield Motors, Chennai

Scooter India Ltd, Kanpur

Sundram Brake Linings Ltd, Chennai

(Continued on page 7)

*(Continued from page 6)**Members*

SHRI S. SELVAMANI
 SHRI MANOHAR M. HEDGE (*Alternate*)
 SHRI S. R. AGARHARI
 SHRI V. R. PALUSKAR
 SHRI G. R. NAGABHUSHAN (*Alternate*)
 SHRI M. N. MURALIKRISHNA
 SHRI ANTON FREIESLEBEN
 SHRI PAULRAJ EDWIN (*Alternate*)
 SHRI S. C. YONEZAWA
 SHRI B. SARKAR (*Alternate*)
 SHRI A. R. GULATI,
 Director & Head (TED)

Representing

Sundram Clayton Ltd, Chennai
 Swaraj Mazda Ltd, Chandigarh
 TELCO, Pune
 TVS Suzuki Ltd, Hosur
 Volvo India Pvt Ltd, Bangalore
 Yamaha Motor Escorts Ltd, Faridabad
 Director General, BIS (*Ex-officio Member*)

Member-Secretary

SHRI A. K. NAGPAL
 Director (TED), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of stardardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publication), BIS

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of ‘BIS Handbook’ and ‘Standards: Monthly Additions’.

This Indian Standard has been developed from Doc: No. TED 4 (233).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:		
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002		Telegrams: Manaksanstha
Telephones: 323 01 31, 323 3375, 323 94 02		(Common to all offices)
Regional Offices:		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17, 323 38 41
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi CALCUTTA 700054	{ 337 84 99, 337 85 61 337 86 26, 337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	{ 60 38 43 60 20 25
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	{ 235 02 16, 235 04 42 235 15 19, 235 23 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	{ 832 92 95, 832 78 58 832 78 91, 832 78 92
Branches	: AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM.	